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Method of recording a stream of audio-visual data

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Method of recording a stream of audio-visual data

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(68)

The invention relates to a method of determining the size of a compressed stream of audio-visual data, wherein the compression has taken place using a variable bit-rate compression, the method comprising the step of determining the duration of the stream of audio-visual data.

5           The invention further relates to a circuit for determining the size of a compressed stream of audio-visual data, wherein the compression has taken place using a variable bit-rate compression, comprising a central processing unit conceived to determine the duration of the stream of audio-visual data.

10           The invention also relates to an apparatus for storing a stream of audio-visual data, comprising a compression controller for compressing the stream of audio-visual data prior to storage of the stream of audio-visual data.

          The invention relates as well to a signal carrying a stream of audio-visual data and meta-data associated with the stream of audio-visual data.

15

US 6,188,650 describes an apparatus for recording a data on a medium. A user is enabled to specify a recording start time, a recording end time, the bit rate of a bit stream and a channel to be recorded in advance. From this information, the file size is calculated and recording area on the medium is reserved.

20           A problem of this apparatus is that when the stream of audio-visual data is compressed prior to storage and compression takes places using a variable bit-rate compression algorithm, the exact bit-rate and therefore the exact size of the (future) stored programme is not known; only a rough estimate.

25

It is a goal of the invention to provide a method that is able to more accurately estimate the size of the stored stream of audio-visual data, when the stream of audio-visual data is compressed according to a variable bit-rate compression algorithm.

This goal is reached with the method according to the invention, characterised in that the method further comprises the following steps: determining the compression technique; determining the complexity of the stream of audio-visual data; and determining the size of the stream of audio-visual data using the information determined in the previous steps.

5 The average bit-rate of a stream of audio-visual data is determined by the complexity of the stream of audio-visual data. When the complexity is low, the stream comprises little information, like a test screen for the full duration of the stream. With high complexity, the stream comprises all different pictures. In the first case, the average bit-rate of the compressed stream will be lower than when the stream of the second case is compressed, even when in both cases the same variable bit-rate compression technique is used, with the same quality level. The complexity of the stream of audio-visual data may be indicated in various ways, as will be apparent from various embodiments of the invention that will be described hereafter.

10 So from the compression technique and the complexity of the stream, an average bit-rate may be determined. With information on the duration of the stream, the size of the stream to be stored can be determined.

In an embodiment of the method according to the invention, the complexity of the stream of audio-visual data is indicated by a factor of information redundancy in the stream of audio-visual data.

20 In this way, the invention may be used for all kinds of variable bit-rate compression techniques. It may not provide the exact size of the compressed stream of audio-visual data for all compression techniques, but will provide a good estimate.

In a further embodiment of the method according to the invention, the complexity of the stream of audio-visual data is derived from meta-data associated with the stream of audio-visual data.

25 This embodiment provides an apparatus using the method according to the invention with the information needed to carry out the method according to the invention in an easy way. The information may even be delivered prior to reception of the stream of audio-visual data.

30 In yet another embodiment of the method according to the invention, the size of the stream of audio-visual data is determined prior to reception of the full stream of audio-visual data.

Using this embodiment of the invention, one contiguous area in a memory where the stream needs to be stored may be allocated for storage of the stream. This is advantageous for embodiments of the invention where the memory is a disk based memory. When the stream is stored in one contiguous area, it can be retrieved continuously, without  
5 sweeping of the pick up unit. This improves the performance of the disk based memory, since no data can be read when sweeping the pick up unit.

The circuit according to the invention is characterised in that the central processing unit is further conceived to: determine the compression technique used to compress the stream of audio-visual data; determine the complexity of the stream of audio-  
10 visual data; and determine the size of the stream of audio-visual data using the information on the duration of the stream of the audio-visual data, the compression technique used to compress the stream of audio-visual data and the complexity of the stream of audio-visual data.

The apparatus according to the invention comprises the circuit according to  
15 claim 10.

The signal according to the invention is characterised in that the meta-data comprises information on the complexity of the stream of audio-visual data.

In an embodiment of the signal according to the invention, the information on the complexity of the stream of audio-visual data is provided prior to providing the stream of  
20 audio-visual data.

In this way, the size of the stream of audio-visual data to store can be determined prior to the reception and storage of the stream of audio-visual data.

These and other aspects of the invention will become apparent from the  
25 drawings, wherein:

Fig. 1 shows a system comprising an apparatus as embodiment of the apparatus according to the invention; and

Fig. 2 shows a flow chart depicting an embodiment of the method according to the invention.

30

Fig. 1 shows a consumer electronics system 100 comprising a recording apparatus 110 as an embodiment of the apparatus according to the invention, a user input device 120 and a display device 130.

The recording device 110 comprises a reception unit 112 for receiving a broadcast signal 150. The broadcast signal 150 may be received by a satellite system, by a cable channel or by other means, the invention is not limited to this. The reception unit 112 derives a stream of audio-visual data from the received broadcast signal 150 that is compliant  
5 to standards commonly used, i.e. PAL, SECAM or NTSC for analogue television and DVB for digital television. The reception unit 112 comprises a tuner to select a channel. When an analogue television signal is received, it is converted to a digital television signal by the reception unit 112.

A user of the system 100 may issue a recording command by means of user  
10 input device 120 comprising a keyboard 122 to order the recording apparatus 110 to record the received stream of audio-visual data.

Upon reception of the recording command, a central processing unit 118 commands a memory 114 to store the stream of audio-visual data. The memory 114 may be a harddisk or an optical disc like DVD or Blu Ray. The memory 114 may also be any other  
15 kind of recording medium including flash EEPROM and the like.

Prior to storage of the stream of audio-visual data, the stream is compressed according to a variable bit-rate compression algorithm like MPEG2 by a compression unit  
113.

The stored stream of audio-visual data can be shown on the display device  
20 130. When doing so, the video part of the stream of audio-visual information is shown on the screen 132 and the audio part is reproduced by means of the pair of speakers 134.

When receiving a recording command to record a stream of audio-visual information in the memory 114, the size of the stream of audio-visual information is not always known on beforehand. In particular, when the recording is started by a manual input  
25 command and no end time of the recording has been set, this is the case. Therefore, it is not known whether there is enough free space in the memory 114 to store the stream of audio-visual information to record. One of the reasons for this is that the duration of the stream of audio-visual information is unknown.

Furthermore, with variable bit-rate compression, the average bit-rate of the  
30 finally compressed and recorded stream is unknown using methods according to the prior art. With variable bit-rate encoding, there is a lower boundary and an upper boundary of the average bit-rate.

For a compression algorithm like MPEG-2, the lower boundary bit-rate is the average bit-rate of a compressed stream of audio-visual data presenting continuously the

same image, like a test screen. In such a stream, only the first frame comprises information, the rest of the stream is redundant data.

The upper boundary bit-rate is the average bit-rate of a compressed stream of audio-visual data in which each frame in a GOP (Group of Pictures) is fully different from all other frames in the GOP. In such a stream, every frame comprises information, at least when considering a GOP.

Basically stated, the bit-rate of a stream of audio-visual data compressed with a variable bit-rate compression algorithm depends on the amount of information in the stream or the complexity of the stream.

The lower and upper boundaries are determined by the compression technology (MPEG 2, MPEG-4, Div/X or other) and the quality of the compressed stream. For MPEG-2, this is dependent on the number of DCT coefficients used during compression.

By supplying a parameter indicating the complexity of a compressed stream relative to the lower boundary on one side and the upper boundary on the other side (or relative to either one of them), an indication of the average bit-rate of the compressed stream can be provided. In a preferred embodiment, this parameter is received with the broadcast signal 150 together with the stream of audio-visual data.

Taken the explanation above into account, the parameter is provided as a measure for data redundancy of the stream of audio-visual data in one embodiment. In a further embodiment, the parameter is provided as an average bit-rate for a given compression algorithm and a given quality level of the compression. In a further embodiment of the invention, multiple parameters may be provided; one for each compression technique/algorithm.

This parameter, combined with the duration of the stream of audio-visual data, which is usually a single programme, and information on the compression algorithm used to compressed, the amount of data to be stored in the memory 114 can be determined. The parameter can be embedded in meta-data sent in compliance with for example MPEG-7, TV-Anytime or a proprietary protocol.

In preferred embodiment, the information on the duration of the programme is derived from an electronic programme guide, also known as an EPG. As an alternative, teletext may be used. The apparatus should know how to interpret a program guide on teletext (which page, how is the page build up). This may be provided by a user, but may also be built into the apparatus upon manufacture. The duration may also be derived from any other kind of meta-data like MPEG-7, TV-Anytime or a proprietary content description

protocol. This information may be distributed along with the stream of audio-visual data, but also through other channels like the internet or a telephone line.

When a recording of a stream of audio-visual data is pre-programmed in the recording apparatus 110, the duration of the programme is already available in the recording apparatus 110 itself. The recording of the stream may be pre-programmed by an EPG protocol or by just setting a start time and an end time. Alignment of recording times with the programme to be recorded may be enhanced using protocols like Program Delivery Control and Showview.

When the recording action is not pre-programmed and the recording is started by e.g. a manual operation of a user, the duration of the programme to record will have to be determined as described in a previous paragraph; by deriving from meta-data the information on the duration of the programme currently showing.

Fig. 2 shows a flowchart 200 depicting an embodiment of the method according to the invention. The method depicted may be used as a sub-routine in a recording process.

The method starts in a startpoint 202 when a command is received to record a television programme and this sub-routine is called upon. Subsequently, the duration of the programme is determined according to one of the methods described above in a process step 204. Next, the compression algorithm used to compress the programme is determined in a process step 206. Usually, – from a cost perspective – one recording apparatus will use only one compression algorithm, so for those embodiments, this step is obsolete.

Having determined the compression algorithm, the quality of the compression process is determined in a step 208. In various known digital video recorders like the TIVO® personal video recorder and the DVD+RW recorder of Royal Philips Electronics, a user is enabled to adjust the quality level of video compression. Given a pre-determined compression algorithm, the quality level set determines the size of the stream of audio-visual data to store to a large extend.

In a next step 210, the complexity of the stream to record is determined. In a preferred embodiment of the invention, a parameter indicating the complexity of the stream of audio-visual data is embedded in meta-data associated with the stream of audio-visual data to record and received together with the stream of audio-visual data. For example, the TV-Anytime data of the programme to record comprises a parameter indicating the complexity of the programme.



Having determined duration, compression technique and the complexity of the programme to record, the size of the compressed stream is calculated in a process step 212. For example, when the duration of the programme is 1 hour and 15 minutes, the maximum bit-rate with the compression algorithm and compression quality used is

- 5 4 Mb (megabit) per second and the complexity factor is 0.6, size of the final stream to store is  $(75 \times 60 \times 4 \cdot 2^{20} \times 0,6) / 8 = 1350$  MB (megabyte).

Finally, in a terminator 214, the result of the calculation in the step 212 is returned to the parent process that has called the sub-routine.

- It will be obvious to any person skilled in the art that steps 204 through 210 do not  
10 necessarily may be performed in the sequence as depicted by the flow chart 200. Also other variations are possible, without departing from the scope of the invention.

- In an advantageous embodiment of the invention, the size of the stream of audio-visual data is determined prior to the reception of the stream of audio-visual data. In this way, one contiguous area in the memory 114 (Figure 1) may be allocated for storage of  
15 the stream. This is advantageous for embodiments of the invention where the memory 114 is a disk based memory. When the stream is stored in one contiguous area, it can be retrieved continuously, without sweeping of the pick up unit. This improves the performance of the disk based memory, since no data can be read when sweeping the pick up unit. For this embodiment, the signal 150-(Figure 1) provides the information on the complexity of the  
20 stream prior to providing the stream of audio-visual data.

- Finally, it should be mentioned that determination of the size of the stream of audio-visual data prior to the reception and storage of the stream is not necessary. It would also be possible to provide the information on the complexity of the stream of audio-visual data in the first half of the stream. When the either the duration of the stream, the  
25 compression algorithm and/or the compression quality are known, already a first rough estimate may be provided on the final size of the compressed and stored stream. This is followed by a more accurate estimation in the course of the programme, using the method according to the invention.

The invention may be summarised as follows:

- 30 When a stream of audio-visual data like a television programme is recorded with a digital video recorder comprising a compression engine for compressing the stream prior to storage using a variable bit-rate compression technique, the size of the full stream to store is unknown. The invention provides a method which solves this problem by providing information on the complexity of the stream to store. With this information, combined with

information on the duration of the stream of audio-visual data and the compression algorithm used to compress the stream, the amount of storage space to be reserved to store the stream of audio-visual data can be determined.

## CLAIMS:

20 12 2002

(68)

1. Method of determining the size of a compressed stream of audio-visual data, wherein the compression has taken place using a variable bit-rate compression, the method comprising the step of determining the duration of the stream of audio-visual data, characterised in that the method further comprises the following steps:
  - 5 (a) determining the compression technique;
  - (b) determining the complexity of the stream of audio-visual data; and
  - (c) determining the size of the stream of audio-visual data using the information determined in the previous steps.\
- 10 2. Method according to claim 1, wherein the complexity of the stream of audio-visual data is indicated by an average bit-rate at a given compression technique.
3. Method according to claim 1, wherein the complexity of the stream of audio-visual data is indicated by a factor of information redundancy in the stream of audio-visual  
15 data.
4. Method according to claim 1, wherein the complexity of the stream of audio-visual data is derived from meta-data associated with the stream of audio-visual data.
- 20 5. Method according to claim 1, wherein the duration of the stream of audio-visual data is derived from meta-data associated with the stream of audio-visual data.
6. Method according to claim 1, wherein the duration of the stream of audio-visual data is derived from an apparatus for storing audio-visual data, the apparatus being  
25 pre-programmed to store the stream of audio-visual data.
7. Method according to claim 6, wherein the apparatus is pre-programmed to record the stream of audio-visual data from a pre-determined start time until a pre-determined end time.

8. Method according to claim 1, wherein the size of the stream of audio-visual data is determined prior to reception of the full stream of audio-visual data.
9. Method according to claim 1, wherein the stream of audio-visual data is analogue and digitised prior to the compression.
10. Circuit for determining the size of a compressed stream of audio-visual data, wherein the compression has taken place using a variable bit-rate compression, comprising a central processing unit conceived to determine the duration of the stream of audio-visual data, characterised in that the central processing unit is further conceived to:
- (a) determine the compression technique used to compress the stream of audio-visual data;
  - (b) determine the complexity of the stream of audio-visual data; and
  - (c) determine the size of the stream of audio-visual data using the information on the duration of the stream of the audio-visual data, the compression technique used to compress the stream of audio-visual data and the complexity of the stream of audio-visual data.
11. Apparatus for storing a stream of audio-visual data, comprising a compression controller for compressing the stream of audio-visual data prior to storage of the stream of audio-visual data and the circuit according to claim 10.
12. Signal carrying a stream of audio-visual data and meta-data associated with the stream of audio-visual data, characterised in that the meta-data comprises information on the complexity of the stream of audio-visual data.
13. Signal according to claim 12, wherein the information on the complexity of the stream of audio-visual data comprises an average bit-rate of at least a part of the stream of audio-visual data.
14. Signal according to claim 12, wherein the information on the complexity of the stream of audio-visual data comprises a factor of information redundancy in the stream of audio-visual data.
15. Signal according to claim 12, wherein the information on the complexity of the stream of audio-visual data is provided prior to providing the stream of audio-visual data.

## ABSTRACT:

20 12. 2002

(68)

When a stream of audio-visual data like a television programme is recorded with a digital video recorder comprising a compression engine for compressing the stream prior to storage using a variable bit-rate compression technique, the size of the full stream to store is unknown. The invention provides a method which solves this problem by providing information on the complexity of the stream to store. With this information, combined with information on the duration of the stream of audio-visual data and the compression algorithm used to compress the stream, the amount of storage space to be reserved to store the stream of audio-visual data can be determined.

10 Figure 1

1/2

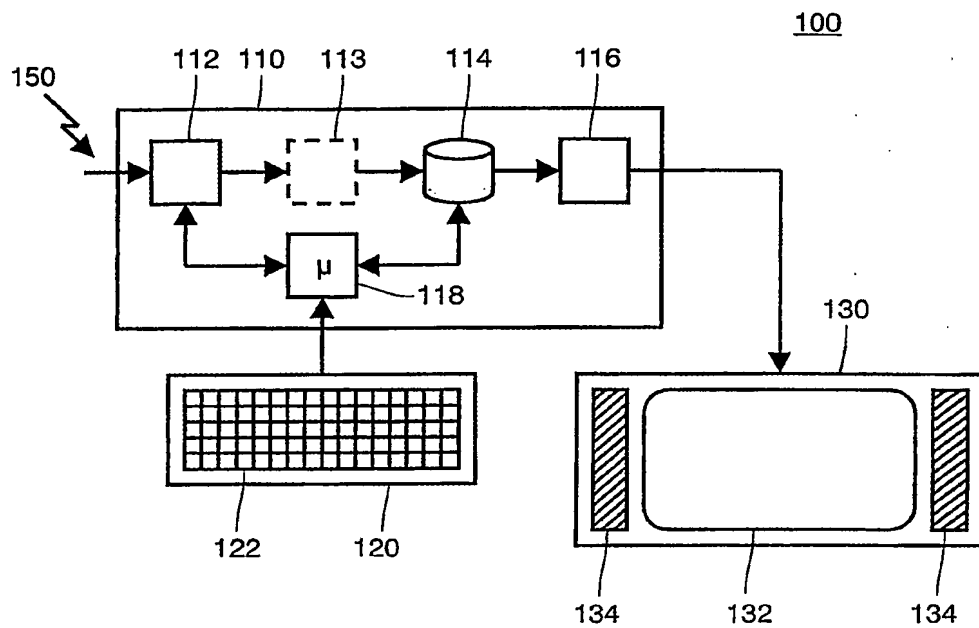


FIG.1

2/2

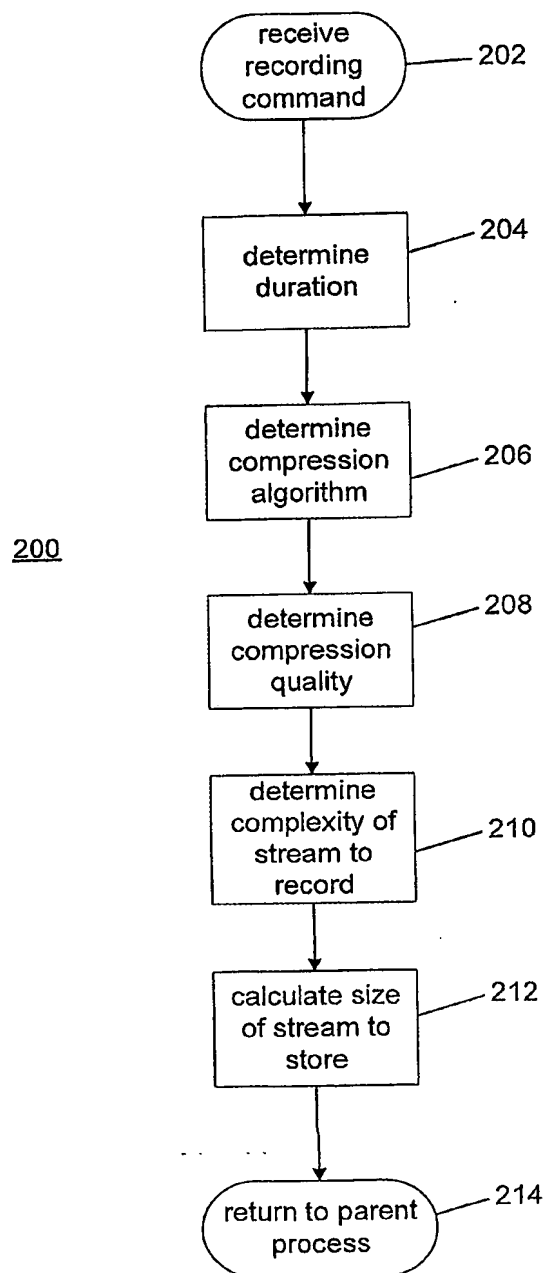


FIG.2

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